

Epidemiological profiles of diabetic ketoacidosis at Moulay El Hassan Ben El Mehdi Hospital in Laâyoune, Morocco

Epidemiology of diabetic ketoacidosis in Laâyoune

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Abstract

Aim: This study aimed to investigate the epidemiological profile of DKA patients in the medicine and intensive care departments at Moulay El Hassan Ben El Mehdi Hospital.

Material and Methods: This was a retrospective descriptive analysis of hospital records of DKA patients admitted to the medicine department and intensive unit care at Moulay El Hassan Ben El Mehdi Hospital in 2021. Among the 222 cases of diabetic ketoacidosis hospitalized, only the hospital records of 46 patients were utilized for analysis. Data were extracted and analyzed with the software SPSS version 20.

Results: The average age of DKA patients was $49,19 \pm 14,9$ years, and the sex ratio (male/female) was 0,85. Type 2 diabetes was predominant with 54,3% (n=25), 19 cases (41,3%) were diagnosed with type 1 diabetes, and 2 patients (4,3%) with recently identified diabetes. 82,7% of our patients were known diabetics with 45,7% (n=21) not in follow-up. At admission, the average blood glucose was $3,61 \pm 1,1$ g/l, 18 patients (39,1%) of our study exhibited glycosuria measuring three crosses (10g/l) and 22 patients (47,8%) had ketonuria equal to three crosses (0,8 g/l). The main precipitating factor of DKA was infection in 63,3% of cases, particularly pulmonary tract with 23,9% and urinary infections in 17,4% of patients. Progression under treatment was marked by 10,9% of deaths. A significant association was found between the type of diabetes, the prognosis of DKA cases, and the hospitalization services.

Discussion: Hospitalization service as associated with the type of diabetes and the prognosis of diabetic ketoacidosis.

Keywords

Diabetic Ketoacidosis, Type 1 Diabetes, Type 2 Diabetes, Inaugural Diabetes

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Introduction

Diabetes is widely recognized as a serious public health burden. It has a significant influence on the overall human health. According to the International Diabetes Federation (IDF), the global prevalence of diabetes mellitus was estimated to be 366 million in 2011, with a projected increase to 552 million by the year 2030 [1]. Uncontrolled diabetes can lead to severe health complications if not properly managed, it is a major determinant of cardiovascular diseases, kidney failure, and neurological and metabolic disorders [2].

Diabetic ketoacidosis (DKA) is a severe metabolic complication of diabetes mellitus and a life-threatening disease, hallmarked by elevated blood glucose levels, ketone production, and metabolic acidosis [3]. Alternatively, it is more frequently observed in individuals with type 1 diabetes but can also manifest in those with type 2 diabetes [4].

DKA and hyperosmolar hyperglycemic state (HHS) are acute, life-threatening complications of diabetes mellitus that necessitate prompt and expert medical intervention. Despite differing pathophysiological mechanisms and clinical presentations, both conditions share the commonality of severe metabolic dysregulation, often precipitated by infection, inadequate insulin therapy, or other stressors [5].

DKA can occur in any country including Morocco [6], where the incidence and prevalence of this complication are influenced by several factors such as the prevalence of diabetes, the availability of healthcare services, and diabetes management practices [7]. However, the epidemiology of DKA in Morocco is not widely documented and specific data on DKA prevalence in the country may be limited.

Locally, in the Laâyoune- Sakia El Hamra region, and to our knowledge, no study has described the epidemiological data of DKA. Accordingly, our study aims to investigate the epidemiological profile of diabetic ketoacidocetosis cases in the Department of Medicine and Intensive Care Unit at Moulay El Hassan Ben El Mehdi Hospital in Laâyoune City, located in Morocco.

Material and Methods

Study design and setting

Our study was a retrospective descriptive study of diabetic patients hospitalized for diabetic ketoacidosis in the medicine department and intensive care unit at Moulay El Hassan Ben El Mehdi Hospital in Laâyoune, Morocco over 1 year from 1 January to 31 December 2021.

Participants

All patients admitted to the Department of Medicine and Intensive Care Unit at Moulay El Hassan Ben El Mehdi Hospital in Laâyoune for diabetic ketoacidosis were included in the study. Out of a total of 222 cases of diabetic ketoacidosis that were hospitalized, only the hospital records of 46 patients were utilized for analysis. Cases with incomplete or missing information, including general data, management guidelines, and monitoring sheets, were excluded from the study.

Variables

We assessed individual, clinical, and biological factors. Demographic factors included age and gender. Factors related to clinical data were medical history, types of diabetes, diabetes

follow-up, known diabetes, hospitalization service, diabetes precipitating factors, and diabetes prognosis. Biological-related factors were blood glucose level, ketonuria, and glycosuria at admission.

Data sources/measurement

Data related to demographic, clinical, and biological factors were collected retrospectively from hospital records of diabetic ketoacidosis patients.

Bias

This is a retrospective descriptive analysis of hospital records of DKA cases. To minimize selection bias, a systematic approach was used to examine only the hospital records that contain complete information on patients diagnosed with diabetic ketoacidosis. Inclusion criteria, such as patients admitted to the internal medicine department and intensive care unit for diabetic ketoacidosis, were defined.

Study size

Forty-six cases of diabetic ketoacidosis were reported in the study from 1 January to 31 December 2021.

Quantitative variables: The following variables have been determined: blood glucose at admission, glycosuria at admission, and ketonuria at admission.

Statistical methods

Data were organized and coded using SPSS version 22 and Microsoft Office Excel. Descriptive analyses were performed with SPSS version 20. Qualitative variables were presented as frequencies and percentages, while quantitative variables were expressed as means $\pm$ standard deviations (SD). Pearson's chi-square tests were employed to assess the relationships between categorical variables and the hospitalization service (Medicine or Intensive Care Unit).

Ethical Approval

Our study was a retrospective, non-interventional investigation. Data collection was conducted with the approval of the Regional Hospital Center of the Laâyoune Sakia El Hamra region. Informed assent and consent were obtained from participants. Autonomy and confidentiality were ensured throughout the data collection and analysis process.

Results

A total of 222 cases of diabetic ketoacidosis were hospitalized, but the hospital records of only 42 patients were used from 1 January to 31 December 2021 in our study as they contained complete information.

Thirty-seven of our patients were hospitalized in the medicine department and nine cases were in the intensive care unit. The average age of patients was $49,19 \pm 14,9$ years with extremes of 16 years and equal to or greater than 60 years (Table 1). The gender distribution was balanced with 53,4% (n=25) females and 45,7% (n=21) males. The majority of our patients (n=25) had type 2 diabetes, accounting for 54,3%, type 1 diabetes was found in 19 patients, representing 41,3% and there were two patients (4,3%) with newly diagnosed diabetes. 38 patients (82,7%) were known diabetics with 17 cases (37%) actively managing their diabetes, while 21 patients (45,7%) were not in follow-up. Among the medical history, high blood pressure is the most commonly found with a proportion of 15,21% (Table 1). In our series, the average blood glucose level at admission was

3,61 ± 1,1 g/l. Glycosuria was negative for two patients (4,3%), in trace amounts for three patients (6,5%), equal to 1 cross (2,5g/l) for nine patients (19,6%), equal to 2 crosses (5g/l) for 12 patients (26,1%), equal to 3 crosses (10 g/l) for 18 patients (39,1%) and equal to 4 crosses (> 20) for two patients (4,3%). Ketonuria was equal to 1 cross (0,15g/l) for seven patients (15,2%), equal to 2 crosses (0,4g/l) for ten patients (21,7%), equal to 3 crosses (0,8g/l) for 22 patients (47,8%), and equal to 4 crosses (≥ 1,6) for seven patients (15,2%) (Table 2).

The major precipitating factors of diabetic ketoacidosis consisted of infections (63,3%), incorrect insulin usage (10,9%), and stopping insulin treatment (8,7%). Within the category of infections, pulmonary tract infections were the most prevalent (23,9%), followed by urinary tract infections (17,4%), and then cutaneous infections (2,2%) (Table 2). Additionally, 78,3% (n=36) of our patients recovered and were discharged, three cases (6,5%) were transferred from the intensive care unit to the medicine department, one case (2,2%) was transferred from the medicine department to the intensive care unit, one case (2,2%) developed infectious complications and five cases (10,9%) have died (Table 2).

The relationships between patient characteristics, clinical

Table 1. Demographic and clinical characteristics of diabetic ketoacidosis cases

Characteristics	Frequency (n)	Percentage (%)
Hospitalization service		
Medicine department	37	-80,43%
Intensive care unit	9	-19,56%
Average age		
Median	51,50	
(IQR)	(42,00- 60,00)	
Mean ± SD	49,19± 2,19	
Gender		
Female (F)	25	-54,30%
Male (M)	21	-45,70%
Type of diabetes		
Diabetes type I	19	-41,30%
Diabetes type II	25	-54,30%
Inaugural Diabetes	2	-4,30%
Known diabetes		
Yes	36	-78,26%
No	10	-21,73%
Diabetes follow-up		
Yes	17	-37,00%
No	21	-45,70%
Unknown	8	-17,40%
Medical history		
Asthma	1	(2,17 %)
High blood pressure	7	-15,21%
Stroke	1	(2,17 %)
Non-prescribed corticoid therapy	1	-2,17%
Myocardial infarction	2	-4,34
Kidney failure	1	(2,17 %)
Anemia	1	(2,17 %)
Neoplastic disease	1	(2,17 %)
No cause	9	(19,56%

factors, and the hospitalization services were evaluated in Table 3. A statistically significant relationship was found between the type of diabetes and the hospitalization services (p=0.01). Additionally, a statistically significant association was observed between the prognosis of DKA cases and the hospitalization services (p<0.001). No associations were found between gender (p=0.5), diabetes follow-up (p=0.9), precipitating factors (p=0.52), age range (p=0.09), and the hospitalization services.

Discussion

Our study revealed that the average age of the patients was 49.19 ± 14.90 years, ranging from a minimum of 16 years to a maximum of 73 years. Additionally, half of the patients were aged 51.50 years or below. These results align with Koffi's study on 359 cases of diabetic ketoacidosis in the Ivory Coast, which reported an average patient age of 49.15 ± 13.49 years [8]. Other studies have documented average patient ages of 40.8 ± 13.3 years and 38.3 ± 18.5 years respectively [9, 10]. Additionally, the average age of onset diabetic ketoacidosis in the international literature varies between 31 and 45 years and it appears that the second and third decades of life are the most affected by this condition according to research conducted in Morocco [11].

Table 2. Biological characteristics, precipitating factors, and prognosis of diabetic ketoacidosis cases

Population characteristics	Frequency (n)	Percentage (%)
Average of glycosuria at admission (g/L)		
0	2	-4,30%
1	3	-6,50%
2,5	9	-19,60%
5	12	-26,10%
10	18	-39,10%
>20	2	-4,30%
Median	5	
(IQR)	(2,50- 10,00)	
Average of ketonuria at admission (g/L)		
0,15	7	-15,20%
0,4	10	-21,70%
0,8	22	-47,80%
≥1,6	7	-15,20%
Median	0,8	
(IQR)	(0,40-0,80)	
Precipitating factors		
Infectious state		
Urinary	8	-17,40%
Pulmonary	11	-23,90%
Cutaneous	1	-2,20%
Stopping insulin therapy	4	-8,70%
Improper use of insulin	5	-10,90%
No cause	17	-37,00%
Prognosis of DKA cases		
Infectious state	1	-2,17%
Transfer to the medicine service	3	
Transfer to the intensive care unit	1	-2,17%
Recovery	36	-78,26%
Death	5	-10,86%

Several international and national studies conducted on diabetic ketoacidosis cases consistently report a female predominance ranging from 51% to 60% [12, 13], corroborating with our findings showing that 54.3% of diabetic ketoacidosis cases are females. It is suggested that this higher prevalence among females could be attributed to female hormones which make women more predisposed to diabetes and DKA compared to males. Additionally, factors such as psychological conflicts, treatment non-adherence, irregular medication intake, and dietary errors might contribute to poorer disease management in women compared to men [14]. Notably, 20% of young women with type 1 diabetes present recurrent episodes of ketoacidosis due to psychological issues complicated by eating disorders [15].

Our study demonstrates that among a total of 46 cases of diabetic ketoacidosis, 19 patients have type 1 diabetes, accounting for 41.3%, while 25 patients have type 2 diabetes representing 54.3%. Additionally, two patients exhibit inaugural diabetes. These results are consistent with other studies indicating the occurrence of ketoacidosis in individuals with type 2 diabetes during insulin deficiency or in the presence of concurrent conditions [16]. Moreover, it was revealed that the occurrence of this decompensation in type 2 diabetics remains less frequent and predominantly affects patients aged over 50

Table 3. Association between patient characteristics, clinical factors, and hospitalization services

Department	Medicine	Intensive care	Chi-square test
Type of diabetes			
Diabetes type 1	15 (32,6%)	4 (8,7%)	0.01
Diabetes type 2	22 (47,8%)	3 (6,5%)	
Inaugural Diabetes	0 (0%)	2 (4,3%)	
Prognosis of DKA cases			
Recovery	35 (76%)	1 (2,1%)	0.000
Infectious state	1 (2,1%)	0 (0%)	
Transfer to the intensive care unit	1 (2,1%)	0 (0%)	
Transfer to the medicine service	0 (0%)	3 (6,5%)	
Death	0 (0%)	5 (10,9%)	
Gender			
Male (M)	16 (34,8%)	5 (10,9%)	0.50
Female (F)	21 (45,6%)	4 (8,7%)	
Diabetes follow-up			
Yes	14 (30,4%)	3 (6,5%)	0.90
No	17 (37%)	4 (8,7%)	
Unknown	6 (13%)	2 (4,3%)	
Precipitating factors			
Urinary infection	7 (15,2%)	1 (2,1%)	0.52
Pulmonary infection	8 (17,4%)	3 (6,5%)	
Cutaneous infection	1 (2,1%)	0 (0%)	
Stopping insulin therapy	4 (8,7%)	0 (0%)	
Improper use of insulin	5(10,9%)	0 (0%)	
No cause	12 (26%)	5 (10,9%)	
Age range			
15-24	4 (8,7%)	0 (0%)	0.09
25-39	6 (13%)	0 (0%)	
40-59	16 (34,8%)	8 (17,4%)	
>= 60	11 (24%)	1 (2,1%)	

years [17]. 82,7% of our patients are known diabetics, with diabetes care in 37% of cases, whereas, 45,7% did not receive any follow-up. These findings align with those of the study conducted by Leye et al. [18] in which 61,76% of patients had a pre-existing diabetes diagnosis of whom 22,54% had regular treatment follow-up before their hospitalization. Additionally, 17,4% of our patients had newly diagnosed diabetes. This is consistent with a study undertaken in the medical emergency and internal medicine departments of Niamey in Niger involving 125 cases of which 35 patients were not previously known to have diabetes, constituting 28% of inaugural diabetic ketoacidosis cases [19]. Furthermore, another study with 170 patients hospitalized in the medicine department of Ndamatou Hospital of Touba in Senegal, revealed that 29,1% of cases presented a newly diagnosed diabetes [20]. It was reported that diabetes education and monitoring reduce acute decompensations, prevent degenerative complications, and improve blood glucose levels [14].

The present study showed pneumonia as the most common infection precipitating DKA in 23,9% of patients. This finding matches with the study of Seth et al. [21] which also found that respiratory tract infection was present in 40,9% of patients in a tertiary care hospital in India, and also with the results of Shahid et al. [22] which pneumonia represented 38,7% of precipitating factors in patients hospitalized in a tertiary care hospital in Pakistan. Urinary tract infection was also the predominant precipitating factor in 17,4% of our cases. A previous study reported a similar result among 30,6% of patients with urinary infections [22]. In our study, infections were followed by insulin-related problems such as irregular insulin therapy in 10,9% of patients and stopping insulin therapy in 8,7% of cases. Previous studies have shown that poor compliance with insulin treatment is the main identifiable precipitating factor of DKA [23]. Other studies suggested that omission of insulin or under-treatment with insulin may be the most important precipitating factor [24].

In our study, the duration of hospitalization in the medicine department and the intensive care unit ranged from one to ten days, and the progression of the disease was favorable in 78,3% of cases. Additionally, out of 125 cases of diabetic ketoacidosis admitted to the medical emergency department and internal medicine department of the national hospital and internal medicine department of the national hospital in Niamey, Niger, 96% of cases exhibited a favorable disease progression [19]. Moreover, the study of Kakoma et al. [25] conducted on 51 cases of diabetic ketoacidosis in the internal medicine department of Johnson Sendwe Hospital in Lubumbashi showed a beneficial disease development in 64,7% of cases. Our data indicates that the mortality rate in patients with diabetic ketoacidosis reached 10,9%. Other authors also reported a high death rate, Kakoma et al. [25] announced a higher lethality in 27,5% of cases, whereas, the Mahamane study reported a mortality rate of 4% [19, 25]. These different proportions may be attributed to the centers' expertise, the patient's age, and the presence of comorbidities.

Conclusion
Diabetic ketoacidosis is prevalent in Laâyoune. It manifests

as type 2 diabetes in the majority of cases. The precipitating factors identified are amenable to specific patient education. In addition to staff training, there is a need for enhanced funding and improved accessibility to healthcare, including medications.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and Human Rights Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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